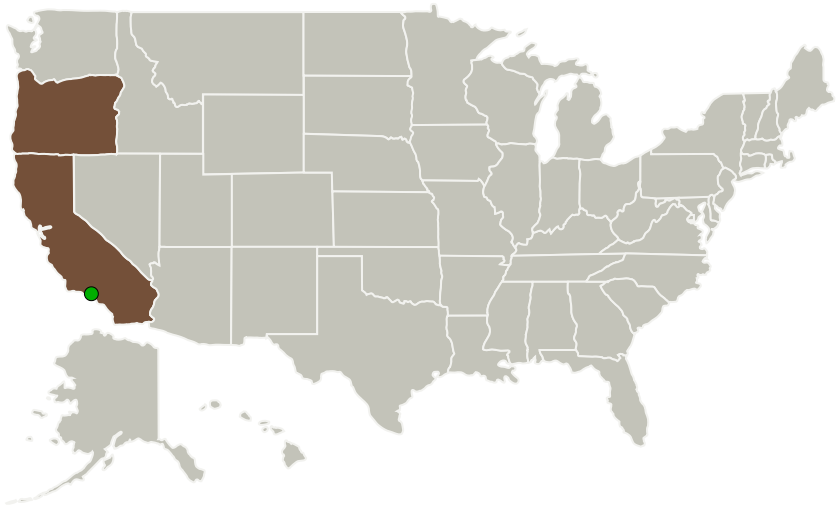
Reservoir Cathode for Electric Space Propulsion, Phase II

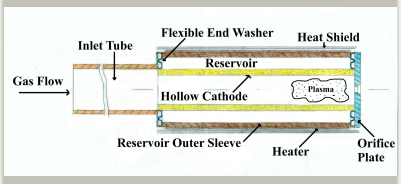
Completed Technology Project (2012 - 2014)

Project Introduction

We propose a hollow reservoir cathode to improve performance in ion and Hall thrusters. We will adapt our existing reservoir cathode technology to this purpose. Reservoir cathodes are the only emission sources that are capable of supplying the necessary current density (>5.0 A/cm2) and life (>100,000 hours) for next generation high-power thrusters. More powerful thrusters are needed for interplanetary and lunar missions, as well as earth escape and near-earth space maneuvers. Reservoir cathodes are able to sustain high rates of barium diffusion to the cathode surface to overcome the high rate of barium removal in ion engines. The key Phase I innovation was flexible supports for the cathode matrix. This prevented the matrix fractures and reservoir leaks of previous reservoir cathodes for ion engines. Cathode operation and stability was verified. In Phase II,the design is refined and tested in actual ion engines. The key challenge is the stresses exerted on the cathode tube and reservoir due to differential expansion and large temperature excursions. These originate from the outside heater and also from heating due to collisions with the cathode. These stresses can lead to fractures and weld failure. Our innovation solves this problem. This was proven on the Phase I device. In Phase II we further test and optimize the Phase I device and perform life testing on it. We build cathode assemblies for insertion into ion engines which we test in an ion environment at e beam, JPL and Colorado State University. Their maximum specific impulse will be measured.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
e-beam, Inc.	Lead Organization	Industry Veteran-Owned Small Business (VOSB)	Beaverton, Oregon
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Oregon

Project Transitions

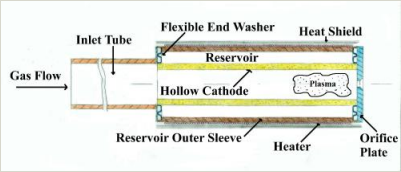
April 2012: Project Start

July 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138463)*

Images



Project Image
Reservoir Cathode for Electric Space Propulsion
(https://techport.nasa.gov/image/132240)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
e-beam, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Bernard K Vancil

Co-Investigator:
Bernard Vancil

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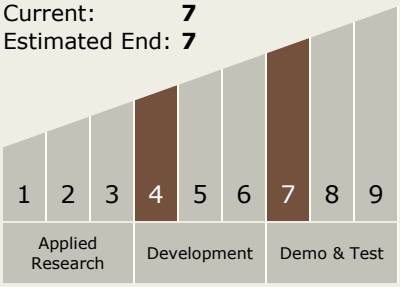
Technology Maturity (TRL)

Start: **4**
Current: **7**
Estimated End: **7**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System